Space Weather Technical Forecast

Issued on Monday 2 December 2024 at 13:13 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low, peaking with a C5.5 flare observed at 01/1622 UTC from AR3906. There are seven regions currently visible, however these are generally simple with their magnetic configuration. The largest regions are AR3905 and AR3906 in the southwest disc. Both regions have remained largely inactive as they now approach the southwest limb, and have been showing signs of slight decay. AR3912 is also of note, as the largest of the regions in the southeast disc, however this is also relatively simple. The other regions remain relatively stable and inactive.

No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds speeds, measured by ACE/DSCOVR at L1, were background to slightly elevated, ranging 380-480km/s. Density was mainly average, dropping below average between 02/0300 -02/0800 UTC. The Interplanetary Magnetic Field (IMF) strength, Bt, was weak to moderate 4-10nT with the north-south component (Bz) remaining weak. Mainly negative (southwards) initially, with a minimum of -5nT, but becoming mainly positive (northward) through the second half of the period, peaking at 6nT. The Phi angle remained largely positive (away from the Sun) throughout. Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was Background. The associated 24-hour fluence remained well below Active. The 02/0000 UTC observed was 1.11e6 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: A slow CME from a filament eruption on 27 Nov has a chance of a glancing impact on day 1 (02 Dec), however only limited enhancements are expected. With no further enhancements from any CME arrivals or Coronal Holes, the solar wind speeds are expected to be slow-ambient to slightly elevated throughout the period. Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals. Any CME enhancement on Day 1 (2 Dec) brings a chance of an Active spell and a slight chance of G1/Minor Storms intervals.

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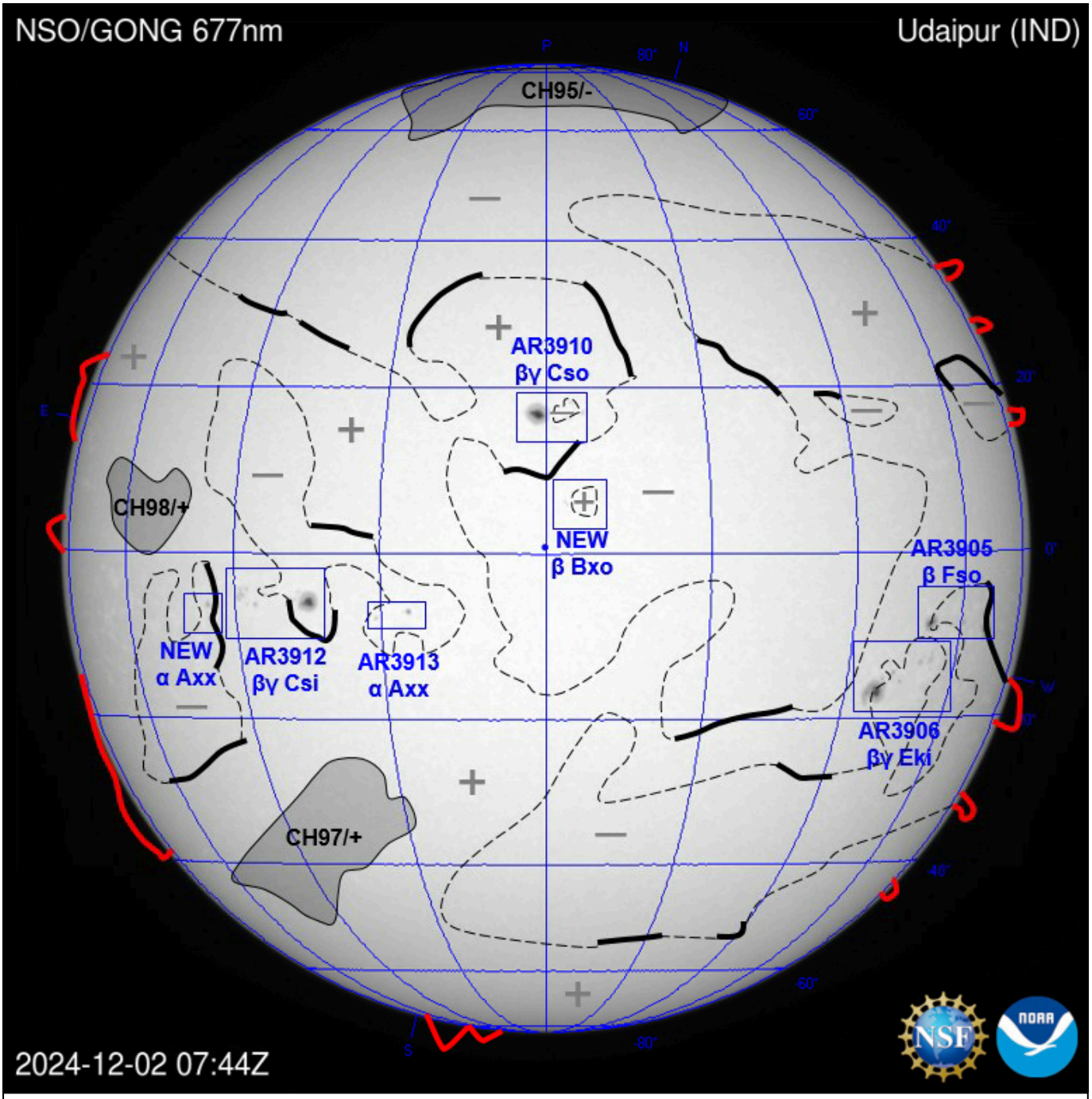
Energetic Particles / Solar Radiation: High energy protons are expected to persist at background with only a slight chance of responding as a result of any notable flare activity. High energy electron flux is expected to persist mainly at background with the associated 24 hour fluence remaining below the Active threshold.

Figure 1: Solar Synoptic Map valid 02/0744 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME associated with a filament eruption off the southeast disc around 27/1900 UTC, has a slight chance of giving a glancing impact, most likely during the second half of day 1 (02 Dec). Any impact is expected to be limited, perhaps bringing Unsettled to Active geomagnetic conditions, and only a slight chance of G1 Minor Storms. Current Solar Orbiter data suggests little evidence of a CME arrival just ahead of Earth, with Bt remaining weak. Otherwise in the absence of any CME enhancement, generally slow-ambient to slightly elevated solar wind speeds are expected throughout the forecast period with no significant Coronal Hole enhancement expected. CH97+ too far south and CH98+ too far east.

MOSWOC Enlil is currently providing reasonable support with slightly elevated winds at present, becoming slow through much of the forecast period. However, the enhancement to the solar wind speeds suggested into day 4 (05 Dec) is viewed with little confidence.

Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals throughout. Any CME enhancement on Day 1 (02 Dec) brings a chance of an Active spell and a slight chance of G1/Minor Storm intervals.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
28/11/2024 04:28	Partial	Filament	SE	390	02/12/2024 14:00 UTC	Moderate confidence of a glancing blow. Minimal enhancement expected.

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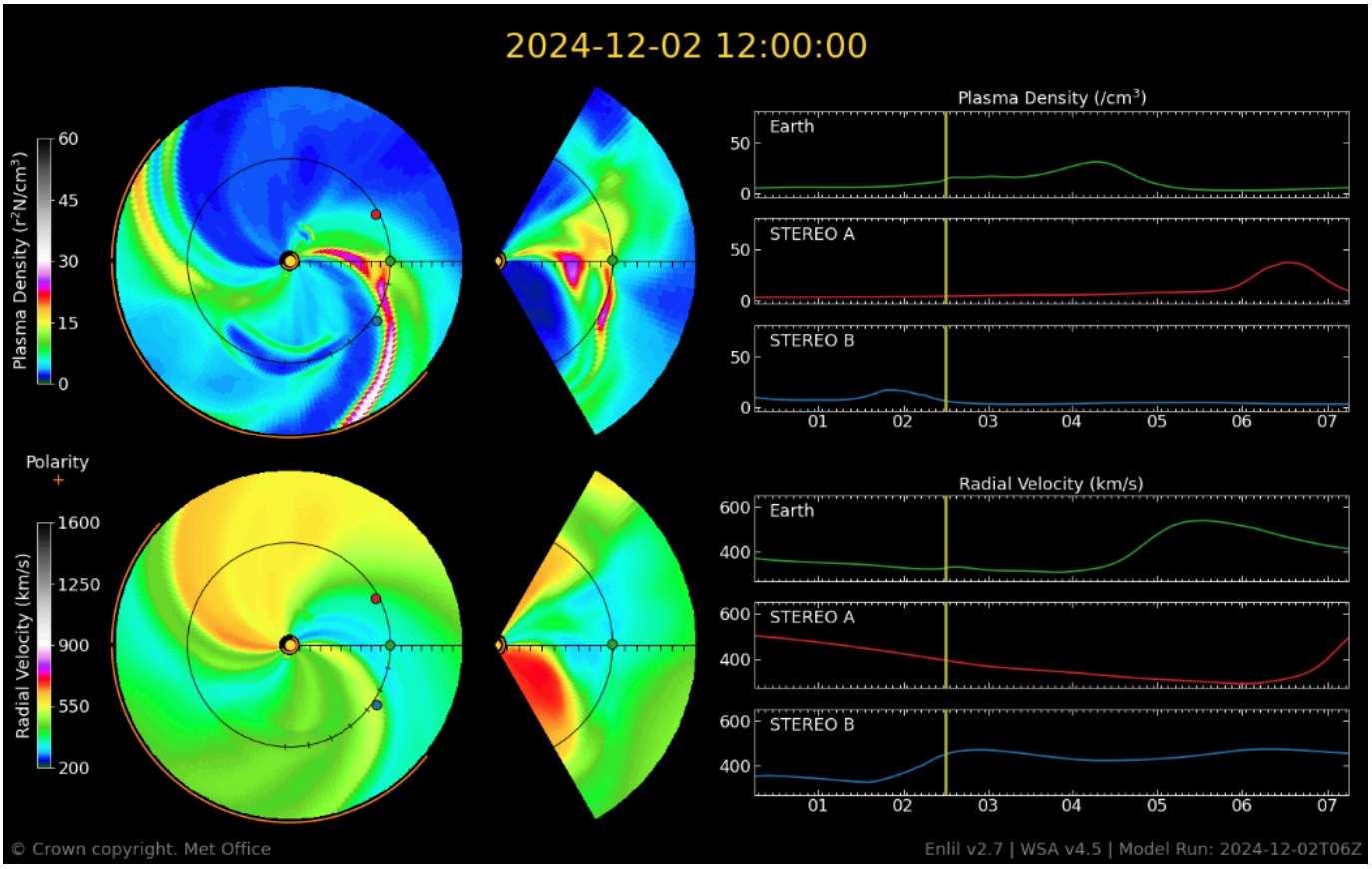
Figure 2: Latest MOSWOC Enlil output



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Radio Blackouts - X-Ray Flares

There are seven regions currently visible, however these are generally simple with their magnetic configuration. The largest regions are AR3905 and AR3906 in the southwest disc. As these regions are in close proximity, may have have some magnetic connection and therefor may slightly increase the complexity on this portion of the disc. Both regions have remained largely inactive as they now approach the southwest limb, and have been showing signs of slight decay. AR3912 is also of note, as the largest of the regions in the southeast disc, however this is also relatively simple. A newly numbered region in the centre of the disc has quickly developed in the last 12 hours, although currently stable. Magnetic looping evident in GOES SUVI 171 and some slight plage on GONG imagery that another sunspot region may appear in the northeastern limb within the next 24 hours. Farside data suggests a number of returning sunspots in the coming days, but this comes with some uncertainty until the rotate onto the disc. The other regions remain relatively stable and inactive.

Overall Low to Moderate activity is expected with a slowly increasing chance of isolated M-class flares as likely oncoming regions add to the complexity on the disk.

Note, assessment of sunspot regions is currently more challenging than usual due to the prolonged outage of available SDO HMI/AIA data with a corresponding lower confidence in flare risk.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	40	40	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

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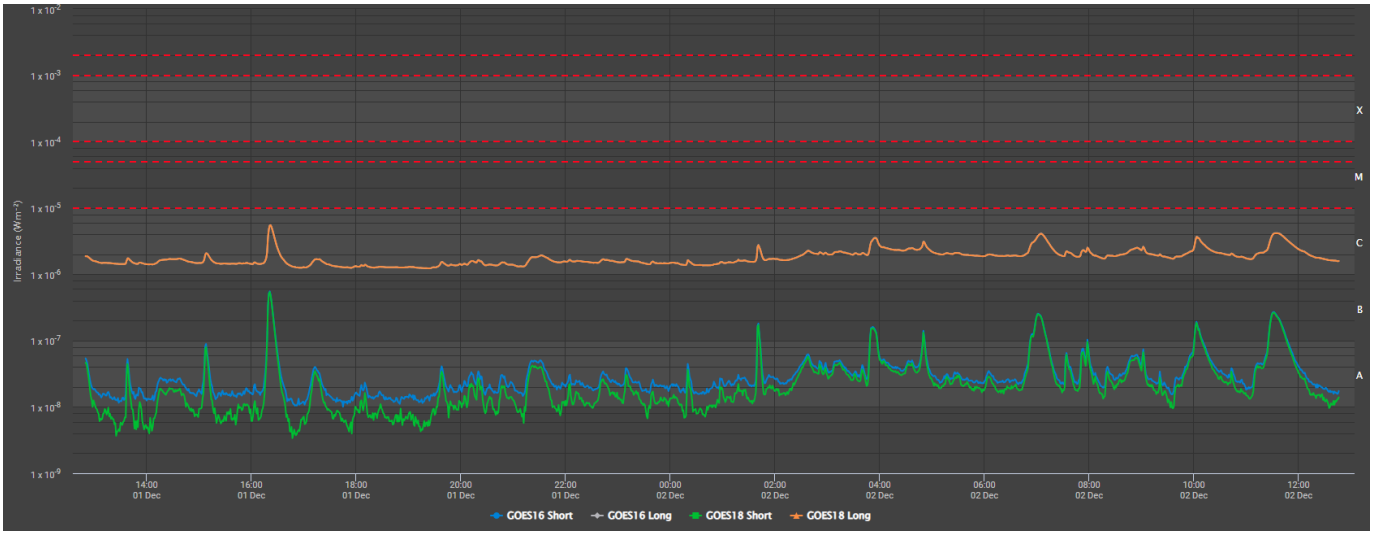
Figure 3: Latest GOES16/18 X-ray flux data, showing only C-class flares.



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Solar Radiation Storms (High Energy Protons)

GOES-18 Proton flux is currently at background. While there are a couple of moderately sized regions on the better connected western disc, these are relatively simple and have remained largely inactive. Along with the other regions on the disc also being relatively small and simple, this only gives a slight chance of high energy proton enhancement through this period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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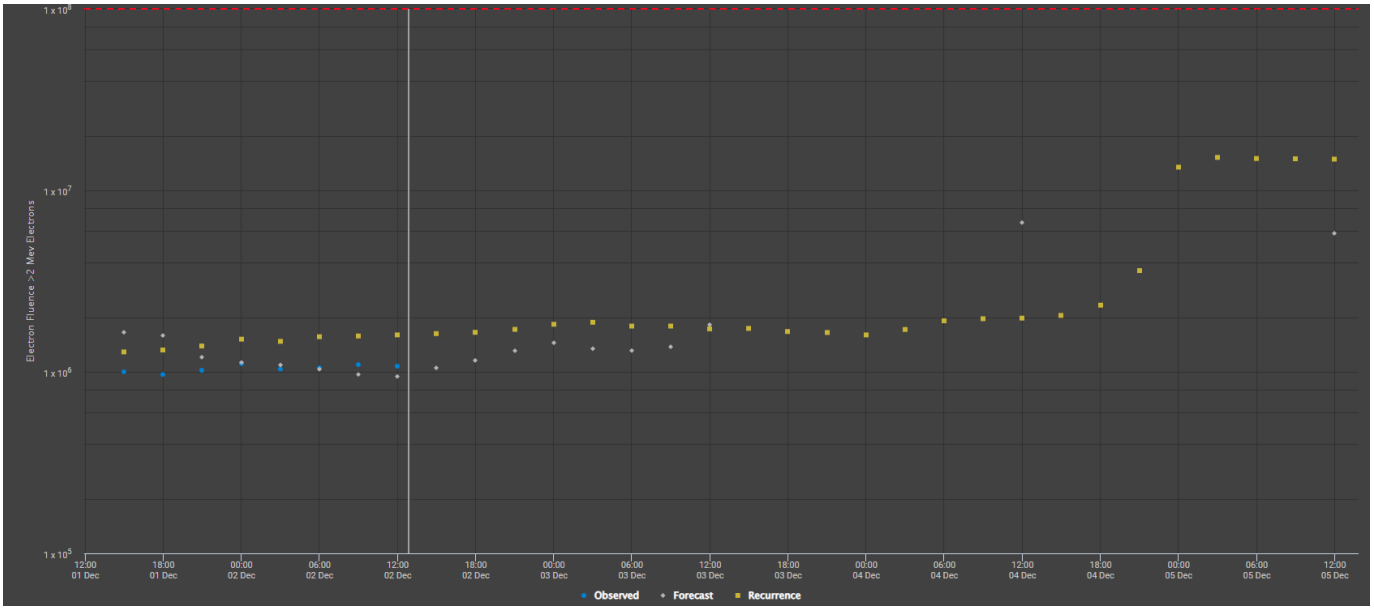
High Energy Electrons (≥ 2MeV)

High energy Electron flux observed by GOES-16 is at Background. This is expected to persist, with no significant coronal hole or CME enhancements currently anticipated during the forecast period.

The associated 24 hr fluence is expected to persist below Active levels, with MOSWOC REFM currently considered to be providing good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: Latest MOSWOC REFM output



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